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under proper conditions of temperature and moisture, is the simplest and most efficient method.

6. Control tests should be used to check the efficiency of the disinfection.

7. Though the results obtained in some cities since abandoning terminal disinfection after certain diseases seem to show that heretofore much useless disinfection has been done, it is not felt that the evidence thus far adduced, fully justifies its discontinuance.

INTESTINAL INFECTIONS.

THE SCHOOL GRADES ATTAINED BY 2,166 WHITE SCHOOL CHILDREN (1,062 BOYS, 1,104 GIRLS) IN THE CITY OF X, CLASSIFIED BY AGE, SANITATION, AND INTESTINAL PARASITES.

By C. W. Stiles, Professor of Zoology, United States Public Health Service.

In a former article[1] it was shown that the school children in the City of X—— who live at homes provided with sewer connection (group S), but without privies, average a lower percentage of infection with intestinal parasites and a lower percentage of unconscious coprophagia than do the children in the same city who live at homes provided with privies (group P).

In the present article, the same white children are classified by age, school grades, and sanitation (in respect to sewer, group S, or privy, group P), to see whether there is any more rapid advancement in school grades by either group—S. children or P. children.

The legal age for entering the first grade at school is 6 years, chronological age, and there are 12 grades in all (including the 4 high school years); each grade is theoretically of 1 year duration in the child's career. Accordingly, a child of 6 years flat to (but not inclusive) 7 years flat (namely, during his seventh year of life) is in his first theoretical school year, and a pupil of 17 years flat to (but not inclusive) 18 years flat is in his twelfth theoretical year of school age. The legal grade that a child is permitted theoretically to enter at a given chronological age thus represents his theoretical school year. Taking these data as basis, it is an easy matter to estimate the percentage of the theoretical legal school advancement a given group of children has made. For instance, if 10 children of 6 years of age (namely, in their seventh year) are in the first grade, they have advanced 100 per cent of the theoretical legal standard; but if 10 children of 7 years of age (in their eighth year) are in the first grade, they have advanced only 50 per cent of the theoretical legal standard, for they represent a theoretical total of 20 grades, but an actual total of only 10 grades.

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[1] Public Health Reports, 1915, v. 30 (27), July 2, 1915, pp. 1991-2002.

Table 1.—*Table of school grades attained by 1,062 white boys in the city of X——; classified by age and by sanitary groups.*

[S=from sewered homes, P=from homes with privy, U=from homes of unknown sanitation, T=total of S, P, and U. Theoretical legal grades are shown by heavy lines.]

Age of pupils.	Total number of pupils in each grade.												Total number of pupils.	School age total.	School grades.		S. A.: S. G. as 100 =x.
	1	2	3	4	5	6	7	8	9	10	11	12			Total.	Average.	
6 S	43	5	1	....	....	....	....	....	....	....	....	....	49	49	56	1.14	114.28
6 P	13	4	....	....	....	....	....	....	....	....	....	....	17	17	21	1.23	123.52
6 U	3	....	....	....	....	....	....	....	....	....	....	....	3	3	3	1.00	100.00
T	59	9	1	....	....	....	....	....	....	....	....	....	69	69	80	1.16	115.94
7 S	42	32	6	2	....	....	....	....	....	....	....	....	82	164	132	1.61	80.50
7 P	13	6	....	....	....	....	....	....	....	....	....	....	19	38	25	1.32	65.80
7 U	7	....	....	....	....	....	....	....	....	....	....	....	7	14	7	1.00	50.00
T	62	38	6	2	....	....	....	....	....	....	....	....	108	216	164	1.52	75.90
8 S	9	42	38	8	....	....	....	....	....	....	....	....	97	291	239	2.46	82.13
8 P	9	13	3	2	....	....	....	....	....	....	....	....	27	81	52	1.92	64.19
8 U	3	2	....	....	....	....	....	....	....	....	....	....	5	15	7	1.40	46.67
T	21	57	41	10	....	....	....	....	....	....	....	....	129	387	298	2.31	77.00
9 S	5	18	39	25	7	1	....	....	....	....	....	....	95	380	299	3.14	78.68
9 P	4	12	11	3	1	....	....	....	....	....	....	....	31	124	78	2.51	62.90
9 U	3	2	....	2	1	....	....	....	....	....	....	....	8	32	20	2.50	62.50
T	12	32	50	30	9	1	....	....	....	....	....	....	134	536	397	2.96	74.06
10 S	5	1	21	30	25	6	1	....	....	....	....	....	89	445	358	4.02	80.44
10 P	1	1	9	7	2	....	....	....	....	....	....	....	20	100	68	3.40	68.00
10 U	1	1	9	4	2	....	....	....	....	....	....	....	17	85	56	3.29	65.88
T	7	3	39	41	29	6	1	....	....	....	....	....	126	630	482	3.82	76.50
11 S	1	1	7	16	22	16	7	1	....	....	....	....	71	426	351	4.94	82.39
11 P	2	2	6	6	7	3	....	....	....	....	....	....	26	156	101	3.88	64.74
11 U	....	1	1	1	1	1	....	....	....	....	....	....	5	30	20	4.00	66.66
T	3	4	14	23	30	20	7	1	....	....	....	....	102	612	472	4.62	77.12
12 S	....	1	5	9	18	22	12	2	1	....	....	....	70	490	384	5.48	78.03
12 P	....	1	3	5	....	7	1	1	....	....	....	....	18	126	88	4.89	69.83
12 U	....	....	1	2	3	5	....	....	1	....	....	....	12	84	65	5.42	77.38
T	....	2	9	16	21	34	13	3	2	....	....	....	100	700	537	5.37	76.71
13 S	1	2	3	6	9	9	24	19	4	....	....	....	77	616	493	6.40	80.03
13 P	....	....	3	2	4	2	4	....	....	....	....	....	15	120	77	5.13	64.16
13 U	....	....	....	....	2	1	2	1	....	....	....	....	6	48	38	6.33	79.16
T	1	2	6	8	15	12	30	20	4	....	....	....	98	784	608	6.20	77.55
14 S	....	....	1	4	5	3	10	11	8	2	1	....	45	405	323	7.18	79.75
14 P	....	....	....	1	1	....	....	1	2	....	....	....	5	45	35	7.00	77.77
14 U	....	1	....	3	1	2	6	1	....	....	1	....	15	135	92	6.13	68.14
T	....	1	1	8	7	5	16	13	10	2	2	....	65	585	450	6.92	76.92
15 S	....	1	....	2	3	....	7	8	14	11	....	1	47	470	386	8.21	82.12
15 P	....	....	....	....	1	1	2	1	2	1	....	....	8	80	61	7.62	76.25
15 U	....	....	....	....	....	1	2	3	4	....	....	....	10	100	80	8.00	80.00
T	....	1	....	2	4	2	11	12	20	12	....	1	65	650	527	8.11	81.07
16 S	....	....	2	....	1	1	1	3	9	7	9	3	36	396	334	9.27	84.34
16 P	1	....	....	....	1	....	....	2	....	....	....	....	4	44	22	5.50	50.00
16 U	....	....	....	....	....	2	1	2	1	....	....	....	6	66	44	7.33	66.66
T	1	....	2	....	2	3	2	7	10	7	9	3	46	506	400	8.68	79.05
17 S	....	....	....	1	....	....	....	3	....	4	4	2	14	168	136	9.71	80.95
17 P	....	....	....	....	....	....	....	....	3	....	1	....	4	48	38	9.50	79.16
17 U	....	....	....	....	....	....	....	....	....	....	2	....	2	24	22	11.00	91.66
T	....	....	....	1	....	....	....	3	3	4	7	2	20	240	196	9.80	81.66
Total S	106	103	123	103	90	58	62	47	36	24	14	6	772	4,300	3,491	4.52	81.18
Total P	43	39	35	26	17	13	7	5	7	1	1	....	194	979	666	3.43	68.03
Total U	17	7	11	12	10	12	11	7	3	....	3	....	96	636	454	4.72	71.38
T	166	149	169	141	117	83	80	59	49	25	18	6	1,062	5,915	4,611	4.34	77.95

TABLE 2.—*Table of school grades attained by 1,104 white girls in the city of X——, classified by age and by sanitary groups.*

[S=from sewered homes, P=from homes with privy, U=from homes of unknown sanitation, T=total of S, P, and U. Theoretical legal grades are shown by heavy lines.]

Age of pupils.	Total number of pupils in each grade.												Total number of pupils.	School age, total.	School grades.		S. A.: S. G. as 100 =X.
	1	2	3	4	5	6	7	8	9	10	11	12			Total.	Average.	
6 S	28	8	....	....	....	....	....	....	....	....	....	....	36	36	44	1.22	122.22
6 P	12	....	1	....	....	....	....	....	....	....	....	....	13	13	15	1.15	115.38
6 U	1	1	....	....	....	....	....	....	....	....	....	....	2	2	2	1.00	100.00
T	41	9	1	....	....	....	....	....	....	....	....	....	51	51	61	1.19	119.60
7 S	25	30	5	....	....	....	....	....	....	....	....	....	60	120	100	1.66	83.33
7 P	15	6	2	....	....	....	....	....	....	....	....	....	23	46	33	1.43	71.73
7 U	5	2	....	....	....	....	....	....	....	....	....	....	7	14	9	1.28	64.28
T	45	38	7	....	....	....	....	....	....	....	....	....	90	180	142	1.57	78.88
8 S	4	32	30	5	1	....	....	....	....	....	....	....	72	216	183	2.54	84.72
8 P	9	7	7	....	1	....	....	....	....	....	....	....	24	72	49	2.04	68.05
8 U	1	1	1	....	....	....	....	....	....	....	....	....	3	9	6	2.00	66.66
T	14	40	38	5	2	....	....	....	....	....	....	....	99	297	238	2.40	80.13
9 S	3	21	12	24	2	....	....	....	....	....	....	....	62	248	187	3.01	75.40
9 P	5	9	16	4	....	....	....	....	....	....	....	....	34	136	87	2.55	63.97
9 U	....	2	2	2	....	....	....	....	....	....	....	....	6	24	18	3.00	75.00
T	8	32	30	30	2	....	....	....	....	....	....	....	102	408	292	2.86	71.56
10 S	4	3	23	28	32	1	....	....	....	....	....	....	91	455	357	3.92	78.46
10 P	1	4	5	11	8	1	....	....	....	....	....	....	30	150	114	3.80	76.00
10 U	....	2	1	1	....	....	....	....	....	....	....	....	4	20	11	2.75	55.00
T	5	9	29	40	40	2	....	....	....	....	....	....	125	625	482	3.85	77.12
11 S	2	....	7	16	25	22	3	....	....	....	....	....	75	420	365	4.87	86.90
11 P	....	1	4	6	7	4	....	....	....	....	....	....	22	132	97	4.40	73.48
11 U	....	....	....	1	1	2	....	....	....	....	....	....	4	24	21	5.25	87.50
T	2	1	11	23	33	28	3	....	....	....	....	....	101	576	483	4.78	83.85
12 S	1	1	3	7	15	19	25	5	....	....	....	....	76	532	444	5.84	83.45
12 P	....	2	2	5	4	4	5	....	....	....	....	....	22	154	109	4.95	70.77
12 U	....	....	....	....	....	2	1	....	....	....	....	....	3	21	19	6.33	90.47
T	1	3	5	12	19	25	31	5	....	....	....	....	101	707	572	5.66	80.90
13 S	....	....	....	3	8	15	28	31	1	....	....	....	86	688	595	6.91	86.48
13 P	....	....	1	8	3	5	6	1	1	....	....	....	25	200	139	5.36	69.50
13 U	....	....	....	....	....	3	....	....	1	....	....	....	4	32	27	6.75	84.37
T	....	....	1	11	11	23	34	32	3	....	....	....	115	920	761	6.62	82.71
14 S	....	....	2	2	5	7	16	30	12	4	1	....	79	711	592	7.49	83.26
14 P	....	....	1	3	3	6	2	2	1	1	....	....	19	171	115	6.05	67.25
14 U	....	....	....	1	1	1	1	2	3	....	....	....	9	81	65	7.22	80.24
T	....	....	3	6	9	14	19	34	16	5	1	....	107	963	772	7.21	80.16
15 S	....	....	....	....	2	5	7	9	31	24	3	....	81	810	713	8.80	88.02
15 P	....	....	....	....	2	1	2	3	5	2	....	....	15	150	119	7.93	79.33
15 U	....	....	....	....	....	....	1	....	1	....	....	....	2	20	16	8.00	80.00
T	....	....	....	....	4	6	10	12	37	26	3	....	98	980	848	8.65	86.53
16 S	....	....	....	....	1	1	....	3	13	25	15	5	63	693	627	9.95	90.47
16 P	....	....	....	....	1	1	2	2	....	1	2	....	9	99	73	8.11	73.74
16 U	....	....	....	....	....	....	....	1	....	3	....	....	4	44	38	9.50	86.36
T	....	....	....	....	2	2	2	6	13	29	17	5	76	836	738	9.71	88.27
17 S	....	....	....	....	....	....	....	1	6	10	10	6	33	396	344	10.42	86.86
17 P	....	....	....	....	....	....	2	....	1	1	....	....	4	48	33	8.25	68.75
17 U	....	....	....	....	....	....	....	....	1	....	....	1	2	24	21	10.50	87.50
T	....	....	....	....	....	....	2	1	8	11	10	7	39	468	398	10.20	85.04
Total S	67	95	82	85	91	70	79	79	63	63	29	11	814	5,325	4,551	5.59	83.58
Total P	42	29	39	37	29	22	19	8	8	5	2	....	240	1,371	983	4.10	71.70
Total U	7	8	4	5	2	8	3	3	6	3	....	1	50	315	253	5.06	80.31
Total T	116	132	125	127	122	100	101	90	77	71	31	12	1,104	7,011	5,787	5.24	80.14

White Boys.

Of 1,189 white boys who gave data of one kind or another, definite information exists as to the school grades of 1,062 pupils 6 to 17 years old, inclusive; of these 1,062 boys, 772 lived at homes (group S) provided with sewers (but without privies), 194 at homes provided with privies (group P), and 96 at homes in regard to which data as to this phase of sanitation are lacking (group U).

A study of the table printed on page 2061 shows that these 1,062 boys are entitled theoretically to 5,915 school grades, representing an average of 5.57 grades. Actually, however, these boys had attained 4,611 grades, representing an average of 4.34 grades. Thus the boys clearly averaged 1.23 grades theoretical retardation, and they made only 77.95 per cent of their theoretical legal standard.

The 772 boys of group S were entitled to 4,300 grades, an average of 5.57 grades. They attained 3,491 grades, an average of 4.52 grades. Thus they averaged a retardation of 1.05 grades and they made only 81.18 per cent of their theoretical legal standard.

The 194 boys of group P were entitled to 979 grades, an average of 5.05 grades. They attained 666 grades, an average of 3.43 grades. Thus they averaged a retardation of 1.62 grades and they made but 68.03 per cent of their theoretical legal standard.

These figures clearly demonstrate that the average boy of group S makes better progress in school than does the average boy of group P. In fact, the average boy of group S is about 13 per cent nearer standard than is the average boy of group P; or taking the boys of group S as standard, the average boy of group P is about 16 per cent behind the average boy of group S.

If the separate years, instead of the totals, are studied, the main conclusion based on the totals is seen to hold for every year except the first, when the boys of group P took the lead.

White Girls.

Of the 1,259 white girls who gave data of one kind or another, 1,104 (of 6 to 17 years old inclusive) gave definite information regarding their school grades; of these 1,104 girls, 814 lived at sewered homes (group S), 240 at privy homes (group P), and 50 at homes in regard to which data as to this phase of sanitation are lacking (group U).

A study of the table printed on page 2062, shows that these 1,104 girls are entitled theoretically to 7,011 school grades, or an average of 6.35 grades. Actually, however, these girls had attained 5,787 grades, an average of 5.24 grades. Thus these girls averaged 1.11 years retardation and they attained only 80.14 per cent of their theoretical legal standard.

The 814 girls of group S were entitled to 5,325 grades, an average of 6.54 grades. They attained 4,551 grades, an average of 5.59 grades. Thus, they averaged 0.95 grade retardation and attained but 83.58 per cent of their theoretical legal standard.

The 240 girls of group P were entitled to 1,371 grades, an average of 5.71 grades. They attained 983 grades, an average of 4.10 grades. Thus, they averaged a retardation of 1.61 grades and attained only 71.70 per cent of their theoretical legal standard.

The figures demonstrate that the average girl of group S makes better progress in school than does the average girl of group P. In fact, the average girl of group S is about 12 per cent nearer standard than is the average girl of group P; or, taking the girls of group S as standard, the average girl of group P is about 14 per cent behind the average girl of group S.

If the separate years, instead of the totals, are studied, the main conclusion based upon the total is seen to hold for every year.

Comparison of White Boys and White Girls.

Comparing the boys and the girls, it is clear that the girls advance more rapidly in school than do the boys of corresponding groups, despite the physiological handicap of girls at age of puberty.

Boys of group S, however, advance more rapidly than do either girls of group P or average girls.

Grades of Children Known to Be Infected With Intestinal Parasites.

Endamoeba coli.—Of the 68 pupils (46 boys, 22 girls) who showed infection with *Endamoeba coli,* 64 (45 boys, 19 girls) gave data regarding their school grades.

Taking the average grade attained in each age and sanitary group as a basis for estimate, these 64 pupils (45 boys, 19 girls) should have attained a total of 312.75 grades (boys 204.14, girls 108.61); actually they attained 340 grades (boys 225, girls 115). Thus these children averaged a gain of 0.43 grade.

Of these 64 pupils, 22 (15 boys, 7 girls) were below the average for their respective groups, and 42 (30 boys, 12 girls) were above the average for the respective groups.

If the various groups are compared, it is seen that they can be arranged as follows:

Six boys of group P, 0.04 grade average gain; 2 girls of group P, 0.08 grade average gain; total girls (19), 0.34 grade average gain; 17 girls of group S, 0.37 grade average gain; total pupils (64), 0.43 grade average gain; 35 boys of group S, 0.45 grade average gain; total boys (45), 0.46 grade average gain; 4 boys of group U, 1.24 grades average gain.

Thus, there is no evidence that this infection caused a retardation in school grades.

Lamblia.—Of 99 children (71 boys, 28 girls) who showed *Lamblia* infection, 91 gave definite data regarding their school grades.

Taking the average grade attained in each age and sanitary group as a basis for estimate, these 91 pupils (65 boys, 26 girls) should have attained a total of 368.03 grades (boys 256.75, girls 111.28); actually they attained 410 grades (boys 283, girls 127). Thus these children averaged a gain of 0.46 grade.

Of these 91 pupils (65 boys, 26 girls), 1 (a boy) was in his correct grade (based on the average of the group), 33 (26 boys, 7 girls) were below the average for their respective groups, and 58 (39 boys, 19 girls) were above the average for their respective groups.

If the various groups are compared, it is seen that they can be arranged as follows:

Eight boys of group P, 0.18 grade average gain; total boys (65), 0.40 grade average gain; 52 boys of group S, 0.40 grade average gain; 9 girls of group P, 0.45 grade average gain; total pupils (91), 0.46 grade average gain; total girls (26), 0.60 grade average gain; 16 girls of group S, 0.68 grade average gain; 1 girl of group U, 0.78 grade gain; 5 boys of group U, 0.81 grade average gain.

The conclusion seems justified that infection with *Lamblia* is not shown to have any influence in retarding school grade advancement (as compared with the average of the respective groups) among the pupils.

Trichomonas.—The number of infections (6) found is too small to warrant statistical comparison, but it may be remarked that 4 stood above the average, and 2 below the average of the respective groups.

Ascaris.—Of the 58 pupils (46 boys, 12 girls) infected with *Ascaris* 53 (41 boys, 12 girls) gave definite data regarding their school grades.

Taking the average grade attained in each age and sanitary group as basis for estimate, these 53 pupils (41 boys, 12 girls) should have attained a total of 213.45 grades (boys 166.38, girls 47.07); actually they attained 210 grades (boys 168, girls 42). Thus these children averaged an almost negligible loss of 0.07 grade (boys average gain of 0.04 grade, girls average loss of 0.42 grade).

Of these 53 pupils, 1 (a boy) was in his correct grade (based on the average of the group); 31 (24 boys, 7 girls) were below the average for their respective groups; and 21 (16 boys, 5 girls) were above the average for their respective groups.

If the various groups are compared they can be arranged as follows:

Seven girls of group S, 1.18 grades average retardation; total girls (12), 0.42 grade average retardation; 2 boys of group U, 0.15 grade average retardation; total pupils (53), 0.07 grade average retardation; 6 boys of group P, 0.03 grade average gain; total boys (41), 0.04 grade average gain; 33 boys of group S, 0.05 grade average gain; 5 girls of group P, 0. 63 grade average gain.

Necator.—Of 83 children (55 boys, 28 girls) who showed hookworm infection, 78 (51 boys, 27 girls) gave data regarding their school grades.

Taking the average grade attained in each age and sanitary group as basis for estimate, these 78 pupils (51 boys, 27 girls) should have attained a total of 357.56 grades (boys 230.30, girls 127.26); actually they attained 340 grades (boys 219, girls 121). Thus these children averaged a deficit of 0.23 grade.

Of these 78 pupils, 1 (a girl) was in her correct grade (based on the average of the group), 42 (31 boys, 11 girls) were below the average for the respective groups, and 35 (20 boys, 15 girls) were above the average for the respective groups.

In connection with these figures it is well to recall that most of these cases of infection (that were found) were light, and that there is a tendency among city children to lighter infections among the girls than among the boys. The point is, however, clear that the hookworm children were retarded below the average of their respective groups.

If the various groups are compared, it is seen that they can be arranged as follows:

Three girls of group U, 1.83 grades average retardation; 2 boys of group U, 0.75 grade average retardation; 13 girls of group S, 0.25 grade average retardation; 34 boys of group S, 0.25 grade average retardation; total pupils (78), 0.23 grade average retardation; total girls (27), 0.23 grade average retardation; total boys (51), 0.22 grade average retardation; 15 boys of group P, 0.09 grade average retardation; 11 girls of group P, 0.23 grade average gain.

If the 3 girls of group U belong really in group P, this group would average a retardation of 0.21 grade.

Oxyuris.—The one boy infected with *Oxyuris* stood above the average for his group.

Hymenolepis nana.—The one boy infected with *Hymenolepis nana* stood below the average for his group.

Summary and Conclusions.

From the foregoing data it seems clear that the 1,104 girls studied attained 80 per cent and the 1,062 boys studied attained 78 per cent of the school grades to which they are entitled on the basis of the legal provision that they may enter the first grade at 6 years of age and on the assumption that they are legally entitled to advance one grade per year. Thus, on the average, the girls made a slightly more rapid advancement than did the boys.

If the children are divided into sanitary groups, according to the presence of a sewer connection or a privy at their homes, it is clear that the children at sewered homes (without a privy) (group S) (girls 84 per cent, boys 81 per cent) advance more rapidly than do the children (girls 72 per cent, boys 68 per cent) who live at homes provided with a privy (group P); boys from sewered homes (group S) (namely, 81 per cent) advance more rapidly than do average girls (80 per cent) and than girls from homes provided with a privy (group P) (namely, 72 per cent).

Thus the home sanitation is an index to two distinct groups of school children.

Many different factors come into consideration in explaining this fact. It would doubtless be unwarranted to assume that the privy, with its attendant dangers, is the only factor that causes this retardation, for many sociological factors certainly play their rôles. It is, however, legitimate to invite attention to the fact that more cases of soil-pollution diseases are to be expected at privy homes (group P) than at sewered homes (group S), and therefore that more absence from school, with consequent retardation, because of these diseases, is to be expected among children from privy homes (group P) than among those from sewered homes (group S); the conclusion therefore seems justified that the privy, with its attendant dangers of disease, is one of the many factors involved in explaining the data submitted.

If we study the cases of different intestinal parasitic infections that are spread through lack of proper disposal of human excreta, the conclusions seem justified that the cases of infection with *Endamoeba coli* and with *Lamblia* do not present any evidence that these two parasites have had any effect in the retardations noted; the statistics for infections with *Ascaris lumbricoides* and with *Necator americanus*, however, tend to support the view that these two parasites are factors that must be considered as of practical importance (less for *Ascaris* than for *Necator*) in connection with retardation, even in cases of relatively light infection, as were most of the cases with which we had to deal; our data for infection with *Trichomonas*, *Oxyuris*, *Trichuris*, and *Hymenolepis nana* are not sufficient to warrant any deduction as respects these parasites.